

**FIELD INVESTIGATIONS OF
UNCONTROLLED HAZARDOUS WASTE SITES**

FIT PROJECT

**TASK REPORT TO THE
ENVIRONMENTAL PROTECTION AGENCY
CONTRACT NO. 68-01-6056**

INSTALLATION
OF
MONITORING WELLS
SAAD SITE
NASHVILLE, TENNESSEE

TDD# F4-8204-06,
06A, 06B, 06C

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ecology and environment, inc.

International Specialists in the Environmental Sciences

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1 10 0003

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Monitoring Well Data

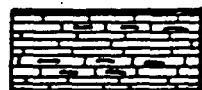
TABLE 2.2

Summary of Water Level Data

LEGEND OF SYMBOLS AND ABBREVIATIONS



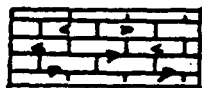
Calcarenite (Bigby-Cannon Limestone)



Argillaceous Limestone (Hermitage Formation)



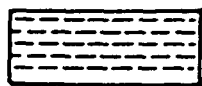
Shelly Limestone



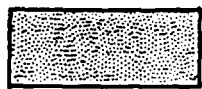
Vuggy Limestone



Shale



Clay and/or Clayey Soil



Unconsolidated Quartz



Apparent Waste Material

CF	Croft Farm
Ctgs.	Cuttings
FB	Franklin Brick Company
Fm.	Formation
FT	Feet
GPM	Gallons Per Minute
H ₂ S	Hydrogen Sulfide
HNu	Brand Name for Photoionizer Meter (Detects presence of organic and some inorganic vapors)
IN	Inches
LDW	Lost Drilling Water
Lms.	Limestone
LN	Louisville and Nashville Railroad
LS	Land Surface
MP	Measuring Point
MSL	Mean Sea Level
PVC	Polyvinyl Chloride
RDF	Roses Dog Food Company
SS	Saad Site
TC	Top of Casing
WL	Water Level
WPZ	Water Producing Zone



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LITHOLOGIC SYMBOLS
AND
ABBREVIATIONS
USED IN THIS REPORT

EXECUTIVE SUMMARY

Under Technical Direction Document Number F4-8204-06, Ecology and Environment, Inc. was tasked to contract the services of a driller and to supervise the installation of seven ground-water monitoring wells at the Saad Site, Nashville, Tennessee.

The Saad Site was first discovered in 1978 when a discharge pond behind the large waste oil storage tanks on site was found to contain waste solvents. In 1979 drums suspected of containing hazardous wastes were found on the site. The Croft Farm Spring, southeast and down gradient of the site, known for past petroleum-related contamination problems and a central natural resource of the planned Cumberland Museum, became the point of interest in the localized ground-water contamination problem.

Seven monitoring wells were installed in the area to confirm the previously acquired electrical resistivity data and to sample the ground water. The hydrogeologic data derived from the wells indicate that the major water producing zones of the Bigby-Cannon Limestone Aquifer are located at the base of the aquifer overlying the Hermitage Formation which acts as a confining layer. A smell similar to diesel fuel was evident in wells down gradient of the L & N property and a smell similar to hydrogen sulfide gas was evident in a well down gradient of the Saad Site. The Saad Site well had a similar odor. Abnormally high HNU meter readings were recorded while drilling into the Saad property overburden, but were not recorded while drilling into the Bigby-Cannon Limestone nor while developing the base fractures and/or solution cavities underlying the Saad Site.

Seven auger holes were also drilled to determine the extent of the Saad Site waste. The waste has affected approximately 0.6 acre and is estimated to be 20 feet deep. The waste volume is estimated to be 18,650 cubic yards. Waste removal problems are very apparent due to the heavily industrialized area over the site.

Of major concern is the source(s) of the odors and reported contamination found in the Croft Spring. The water quality analyses are as yet incomplete, therefore it is impossible to determine contamination sources at this time. A report addressing the results of the water quality analyses will be prepared at a future date.

1.1 MONITORING WELL INSTALLATION

Under Environmental Protection Agency (EPA) Technical Direction Document (TDD) Number F4-8204-06, Ecology and Environment, Inc. (E&E) was tasked to contract the services of a driller and to supervise the installation of seven ground-water monitoring wells at the Saad Site, Nashville, Tennessee. The purposes of the wells were to confirm the electrical resistivity data previously acquired and to sample the ground water in the area. Throughout the drilling operations a cooperative working arrangement was maintained between EPA, E&E, Mr. B. R. "Buck" Allison, Natural Resource Management Consultant for the Cumberland Museum, Mr. Don Rima and his staff of the Tennessee Department of Public Health, Division of Water Quality Control, and Mr. Frank Alexander and his staff of the Tennessee Department of Conservation, Division of Water Resources. The wells were installed between August 19, 1982 and September 17, 1982.

This report addresses the drilling and installation of the wells and the hydrogeological interpretation of the data. The sampling and water quality analytical results will be addressed in another report prepared under TDD F4-8207-12.

1.2 SITE LOCATION

The Saad Site is located on the property of John P. Saad and Sons, Inc., 3655 Trousdale Boulevard, Nashville, Tennessee (Figure 1.1). The site is approximately six miles southeast of downtown Nashville adjacent to the Louisville and Nashville (L & N) Radnor Railroad Yards. A location reference point of the site is monitoring well SSS1 installed at the rear of the property. This well is located at 36°05'28" latitude and 86°45'02" longitude.

1.3 PHYSICAL DESCRIPTION

The Saad Site is located in a highly developed industrial area of Nashville. The site is bordered on the west by L & N Radnor Yards, on the north by Klein Koach Company, on the east by Trousdale Boulevard, and on the south by Franklin Brick Company. The only undeveloped area near the Saad Site is the Croft Farm located southeast of the site across Trousdale



SAAD SITE

CROFT SPRING

0 2000 FEET

SCALE

**REFERENCE: ANTIOCH AND OAK HILL
TOPOGRAPHIC QUADRANGLE MAPS**



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SAAD SITE

NASHVILLE, TN.

LOCATION OF SAAD SITE

TDD F4-8204-06

FIGURE 1.1

Boulevard. The Croft Farm is presently under cultivation along Trousdale Boulevard. The Croft Estate is to be willed to the Cumberland Museum which plans to restore the homestead and create a natural wildlife area. The main surface water resource of the farm is the Croft Spring near the homestead.

The immediate area of the site is topographically uniform, but the development in and around the site has hidden the presence of a sinkhole. The site was at the north end of a relatively large sinkhole. The sinkhole has reportedly been filled by typical landfill waste, boulders, concrete, and fill dirt. Another sinkhole is located on the L & N Radnor Yards just west of the Saad Site. This sinkhole has also undergone development but is still a visible depression in the land surface.

Surface-water drainage at the site is derived from a natural ditch north of the site between the multiple L & N tracks and the buildings on the west side of Trousdale Boulevard. After normal rainfalls, ponded water seeps into the ground behind the buildings. After heavy rains, drainage reportedly flows south to Franklin Brick Company where it slowly seeps into the ground. This seepage point is the location of the filled sinkhole. Surface-water drainage from along Trousdale Boulevard south of the site also flows toward this seepage point in a man-made ditch.

1.4 SITE HISTORY

John P. Saad & Sons, Inc. began a waste oil pick-up service at 3655 Trousdale Boulevard in 1970. Waste oil was brought to the site in tank trucks. There are presently eleven large storage tanks on the site. In March 1978 Tennessee Department of Public Health officials discovered a discharge pond behind the Saad property which contained waste solvents. In 1979 drums suspected of containing hazardous wastes were found on the site. Following numerous state legal actions Mr. Saad made an application on February 27, 1982 to have the drums removed. In March 1982 the Water Resources Division of the Tennessee Department of Conservation was consulted about the past petroleum related contamination of the Croft Spring and how the Saad waste might impact the spring. During March 1982 visits to the site and the spring were made by Tennessee Public Health and Conservation Department personnel and EPA Region IV personnel. Also during March Mr. Saad was given state approval to remove the drums to an

approved hazardous waste landfill (Rima, 1982).

The Croft Spring, as a natural water resource in the planned wildlife area of the Cumberland Museum, and as a major discharge point down gradient of the Saad Site and the L & N property, has played a major role in past investigations in the area. The brown color in this spring has been of concern and has been thought to be linked to ground-water contamination in the Bigby-Cannon Limestone. The brown color was identified in Septmeber 1982 by Mr. Harold Mulican, chemist with the Tennessee Department of Public Health, as an iron-fixing bacteria. The Department of Public Health is presently attempting to identify the species of iron-fixing bacteria in order to determine what nutrients in the spring are aiding the growth of the bacteria (Rima, 1982).

In April 1982 E & E personnel, EPA's Field Investigation Team (FIT), conducted electrical resistivity surveys on the Saad Site, L & N property, and the Croft Farm in an effort to identify ground-water flow paths and contamination in the area. In conjunction with the above geophysical investigation, FIT obtained surface soil samples adjacent to the site, backhoe samples to a depth of six feet on the site, and spring and surface-water samples down gradient of the site during May and August 1982. To confirm the resistivity data and to obtain ground-water samples, seven monitoring wells were installed during August and September 1982. These wells were sampled after installation. A report on the analytical results of all FIT sampling will be issued when all analytical testing for the Saad Site has been completed.

SECTION 2 - MONITORING WELLS

2.1 LOCATION

Ground-water monitoring wells were installed at seven locations to confirm the previously conducted electrical resistivity surveys and to sample the groundwater in the area (See TDD F4-8204-04 report). Figure 2.1 shows the location of the wells. Table 2.1 is a summary of the well data. All wells tap the Bigby-Cannon Limestone Aquifer.

2.2 CONSTRUCTION

The monitoring wells were constructed using the mud rotary method of drilling. GEOTEK Engineering Company, Nashville, Tennessee, was the drilling subcontractor. Appendix A contains construction drawings of each well. All significant drilling occurrences are indicated in each drawing.

The basic drilling procedure consisted of advancing the hole with seven-inch diameter hollow stem augers to bedrock. The augers were pulled from the hole and four-inch diameter stainless steel casing was installed and cemented in-place. The hole was then advanced with a four-inch diameter roller-cone bit to total depth. On occasion construction changes were necessary as drilling conditions changed. All wells were developed with an air compressor to remove the excess cuttings and to determine the estimated water yield of the well. Figure 2.2 shows the significant well development results for each well. By comparing Figures 2.2 and 2.3 it can be seen that the resistivity interpretations were for the most part confirmed by the drilling. Wells SSCF3, SSCF4, SSLN1 and SSS1 were anticipated to yield the presence of ground-water contamination. Wells SSCF3, SSCF4, and SSLN1 did in fact yield water which had a smell similar to diesel fuel. Well SSS1 did yield the presence of a smell similar to hydrogen sulfide gas and a waste-like material was indicated by the HNU meter to be above the Bigby-Cannon Limestone. Water quality analytical results are of course needed to definitely confirm the presence of contamination.

As an example of the resistivity data indicating the presence of fractures and/or solution cavities, Figure 2.4 is a comparison of resistivity sounding R-511 and well log SSCF4. The sounding indicated

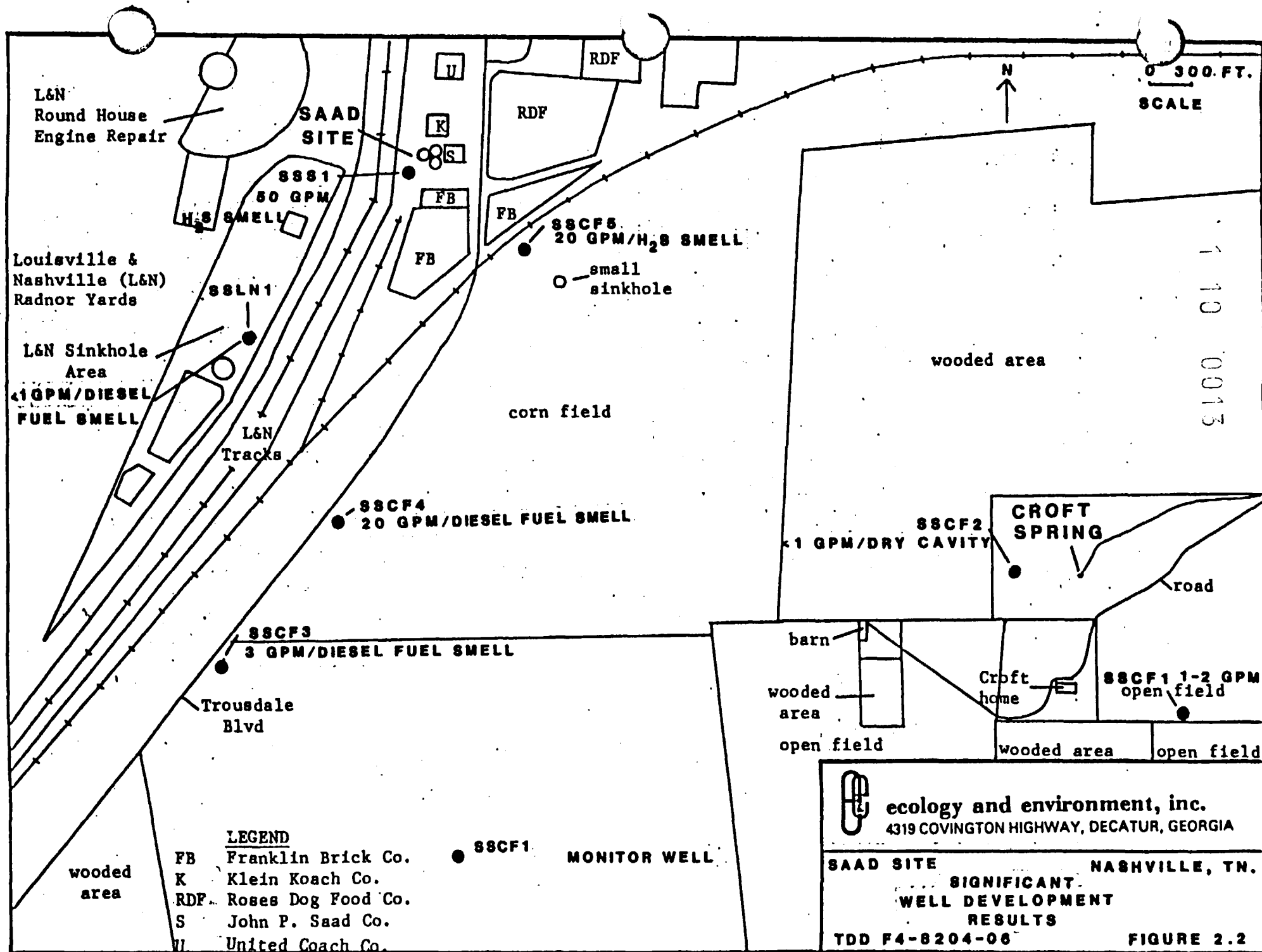
TABLE 2.1
MONITORING WELL DATA
SAAD SITE, NASHVILLE, TENNESSEE

WELL NUMBER	LOCATION	LATITUDE LONGITUDE	LAND SURFACE ELEVATION (FT>MSL)	DEPTH (FT)	DIAMETER (IN)	LENGTH ¹ OF CASING (FT)	PRINCIPAL WATER BEARING UNIT	ESTIMATED YIELD ² (GPM)	REMARKS
SSCF 1	Croft Farm	36°05'13" 86°44'40"	577.6	54.5	4	8	Bigby-Cannon Limestone	1-2	
SSCF 2	Croft Farm	36°05'19" 86°44'44"	567.6	40	"	20.1	"	<1	Dry Cavity
SSCF 3	Croft Farm	36°05'16" 86°45'09"	595.7	43.7	"	33.8	"	3	Diesel Fuel Smell
SSCF 4	Croft Farm	36°05'18" 86°45'05"	581.9	45.6	"	33	"	20	Diesel Fuel Smell
SSCF 5	Croft Farm	36°05'25" 86°44'58"	572.6	49	"	6.4	"	20	Hydroge Sulfid. Smell
SSLN 1	L & N RR Yards	36°05'23" 86°45'09"	583.6	50	"	11.8	"	<1	Diesel Fuel Smell
SSS 1	John P Saad Property	36°05'28" 86°45'02"	583.8	45.6	"	16.6	"	50	Hydroge Sulfid Smell

¹ Length of casing below land surface.

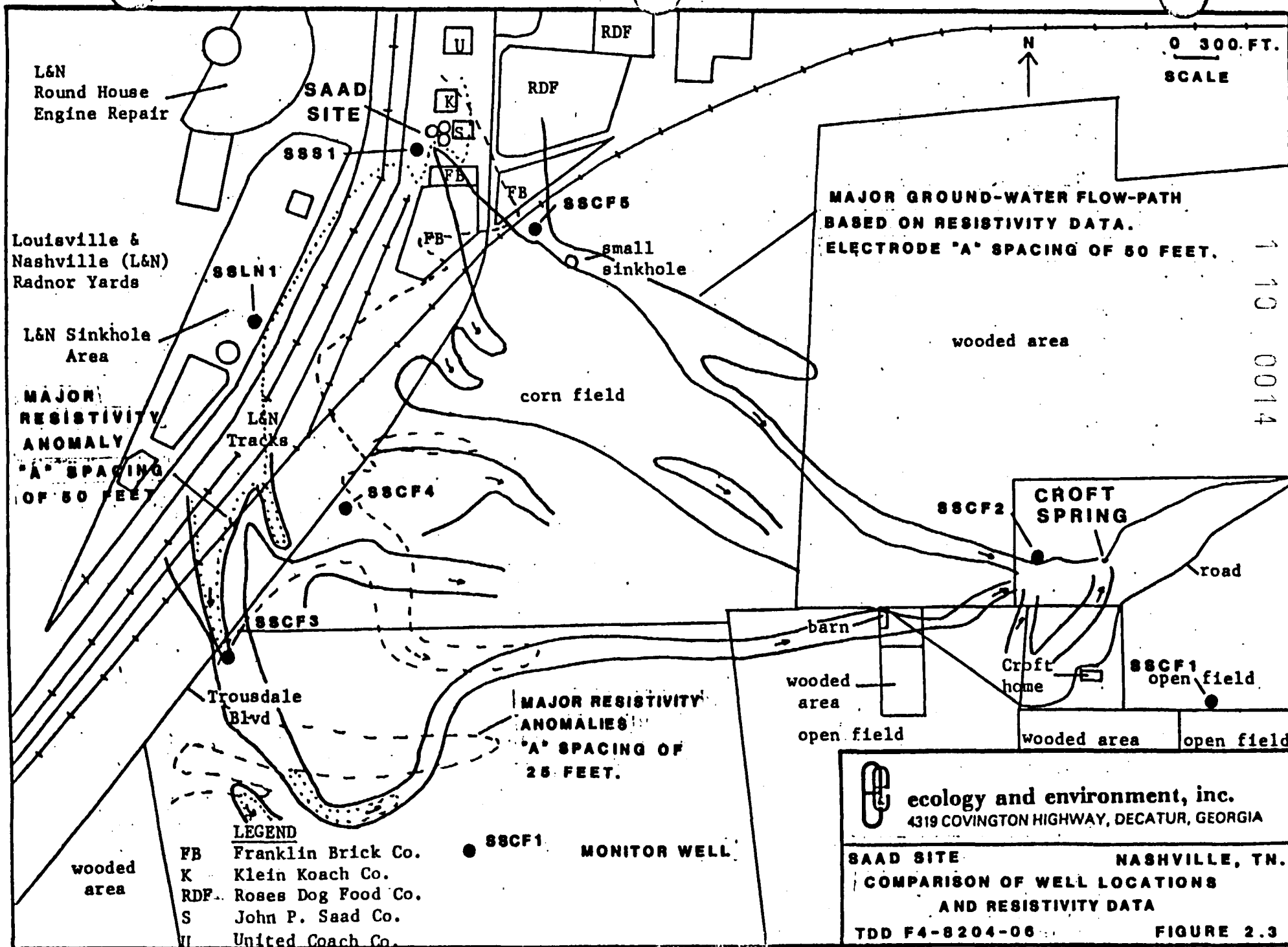
² Yield estimated during well development.

1 10 0012



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SAAD SITE NASHVILLE, TN.
SIGNIFICANT
WELL DEVELOPMENT
RESULTS
TDD F4-8204-06 FIGURE 2.2



1 10 0015

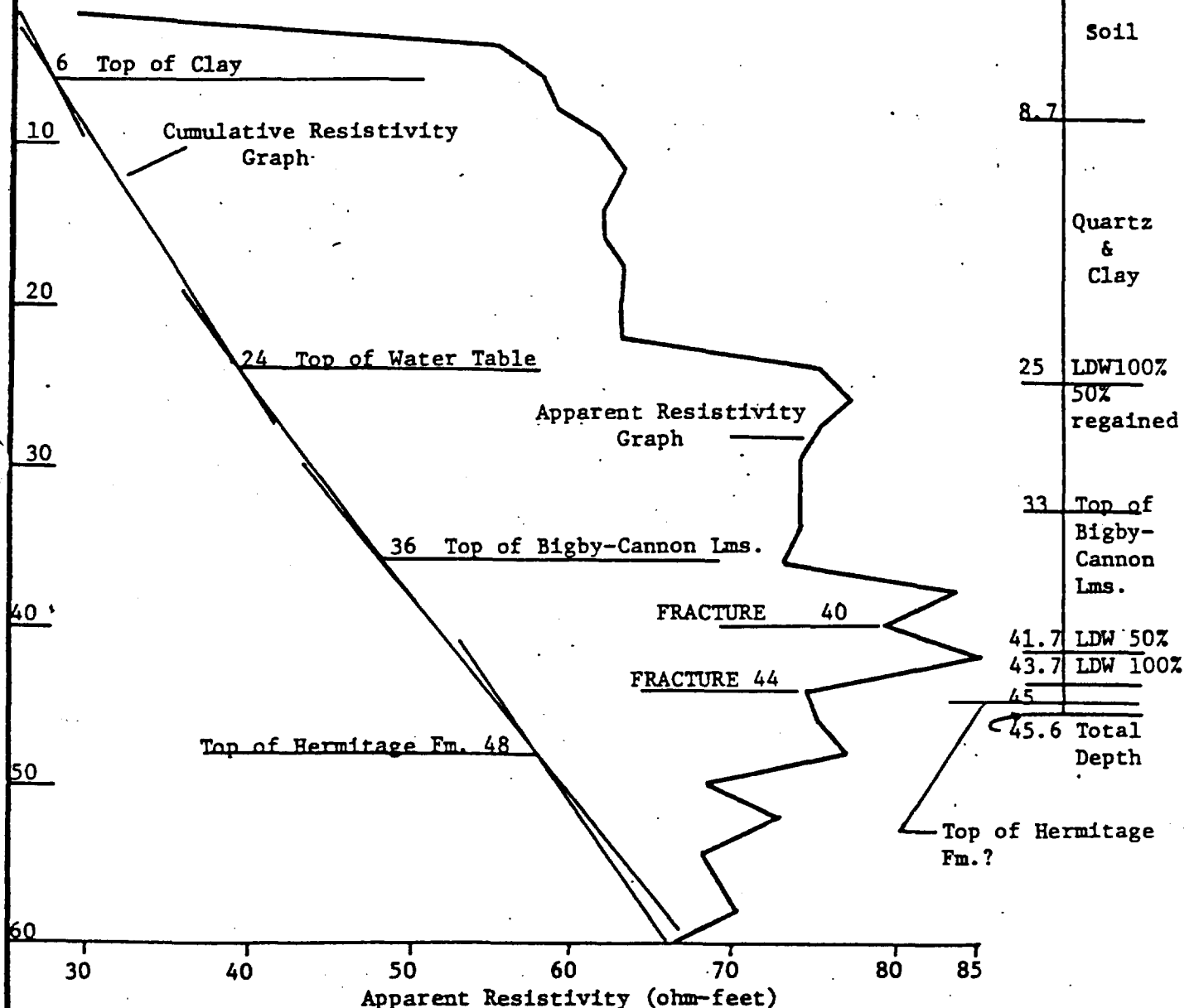
Interpretations of Resistivity Data

Actual Field Data

Well Log
SSCF4Depth In
Feet Below
Land SurfaceResistivity Sounding R-511
Cumulative Resistivity (ohm-feet)

0 500 1000 1500 2000 2500

0



- NOTES: 1. Resistivity sounding conducted on 4-23-82. Well SSCP4 drilled 8-31-82 to 9-3-82.
2. R-511 located 10 feet south of Well SSCP4.



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SAAD SITE. NASHVILLE, TN.
COMPARISON OF SOUNDING R-511
AND
WELL LOG SSCP4
TDD F4-8204-06 FIGURE 2.4

resistivity changes at depths of 6, 24, 36, 40, 44, and 48 feet. The actual well log shows a lithologic change at 8.7 feet, a hydrologic change at 25 feet, another lithologic change at 33 feet, hydrologic changes (fractures and/or solution cavities) at 41.7 and 43.7 feet, and a final lithologic change at 45 feet deep. The resistivity sounding, although not located directly at the well location, varied at most by only three feet from actual log data. This type of close correlation was evident at most well locations where soundings were available for comparison.

2.3 DATA INTERPRETATION

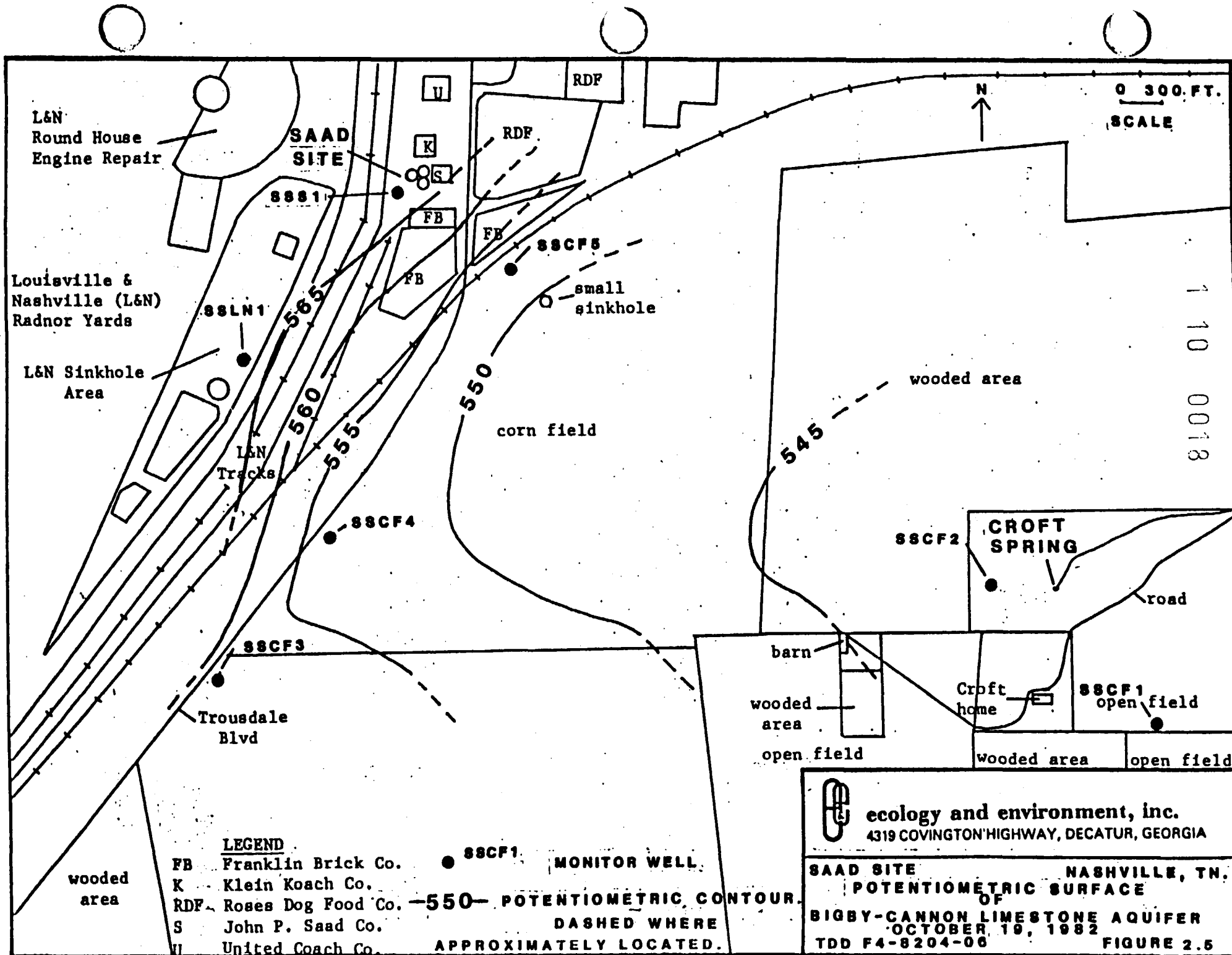
The data interpretations are both hydrologic and geologic in nature. The hydrologic interpretations are based on numerous water level measurements, the last of which were taken on October 19, 1982 by Don Rima and Luke Ewin, Tennessee State personnel. Table 2.2 is a summary of the water level data. Five of the seven wells have water levels which recovered to a level close to their original levels after bailing and sampling. Wells SSCF1 and SSLN1 showed significant water level differences from their original levels. Well SSCF1 did not recover even after 56 days since bailing probably due to a lack of aquifer recharge. In contrast, Well SSLN1 recovered above its original level. The water reached a level corresponding to the stained and weathered limestone at 15 feet below land surface. This is the same point at which a slight diesel fuel smell was noticed while drilling Well SSLN1.

Another hydrologic interpretation obtained from the data is the potentiometric surface map of the Bigby-Cannon Limestone Aquifer shown in Figure 2.5. All wells except SSCF1 are considered to be hydraulically linked to one another and to the Croft Spring. The main fractures and/or solution cavities in each well were encountered at the base of Bigby-Cannon Limestone. These fractures and/or solution cavities, the principal water producing zones of each well, are probably concentrated at the base due to the Hermitage Formation which acts as the lower confining unit. Figure 2.5 indicates that based on existing data the ground-water flow direction in the area is east from L & N and the Saad Site to the Croft Spring. The L & N, Saad and most of the cultivated Croft Farm areas are recharge zones for the Bigby-Cannon Limestone while the Croft Spring is a discharge point for the Bigby-Cannon. Other recharge and discharge

TABLE 2.2
SUMMARY OF WATER LEVEL DATA
SAAD SITE, NASHVILLE, TENNESSEE

WELL NUMBER	LAND SURFACE ELEVATION (FT>MSL)	WATER LEVEL ¹ BELOW LAND SURFACE (FT)	DATE OF WATER LEVEL	WATER LEVEL ELEVATION (FT>MSL)	REMARKS
SSCF 1	577.6	30.8	8-23-82	546.8	prior to completion
		38.6	8-24-82	539	after completion
		32.6	8-25-82	545	after 1 day
		33.1	8-26-82	544.5	after 2 days
		33.8	8-27-82	543.8	after 3 days
		51.8	10-19-82	525.8*	56 days after bailing
SSCF 2	567.6	26.1	8-25-82	541.5	prior to completion
		25.8	8-26-82	541.8	after completion
		25.8	8-27-82	541.8	after 1 day
		26.5	10-19-82	541.1	54 days after sampling
SSCF 3	595.7	35.8	8-30-82	559.9	prior to completion
		30.6	8-31-82	565.1	after completion
		31.1	9-1-82	564.6	after 1 day
		36.3	10-19-82	559.4	33 days after sampling
SSCF 4	581.9	28.4	9-7-82	553.5	4 days after completion
		30.7	10-19-82	551.2	33 days after sampling
SSCF 5	572.6	20.8	9-13-82	551.8	4 days after completion
		21.2	10-19-82	551.4	33 days after sampling
SSLN 1	583.6	42.6	9-14-82	541.0	15 hours after development
		42.6	9-14-82	541.0	21 hours after development
		49.3	9-14-82	534.3	after bailing
		14.5	10-19-82	569.1*	33 days after sampling
SSS 1	583.8	13.3	9-17-82	570.5	1 hour after pumping
		15.1	10-19-82	568.7	32 days after sampling

¹ See Appendix A for water level measuring points
* Significant water level changes

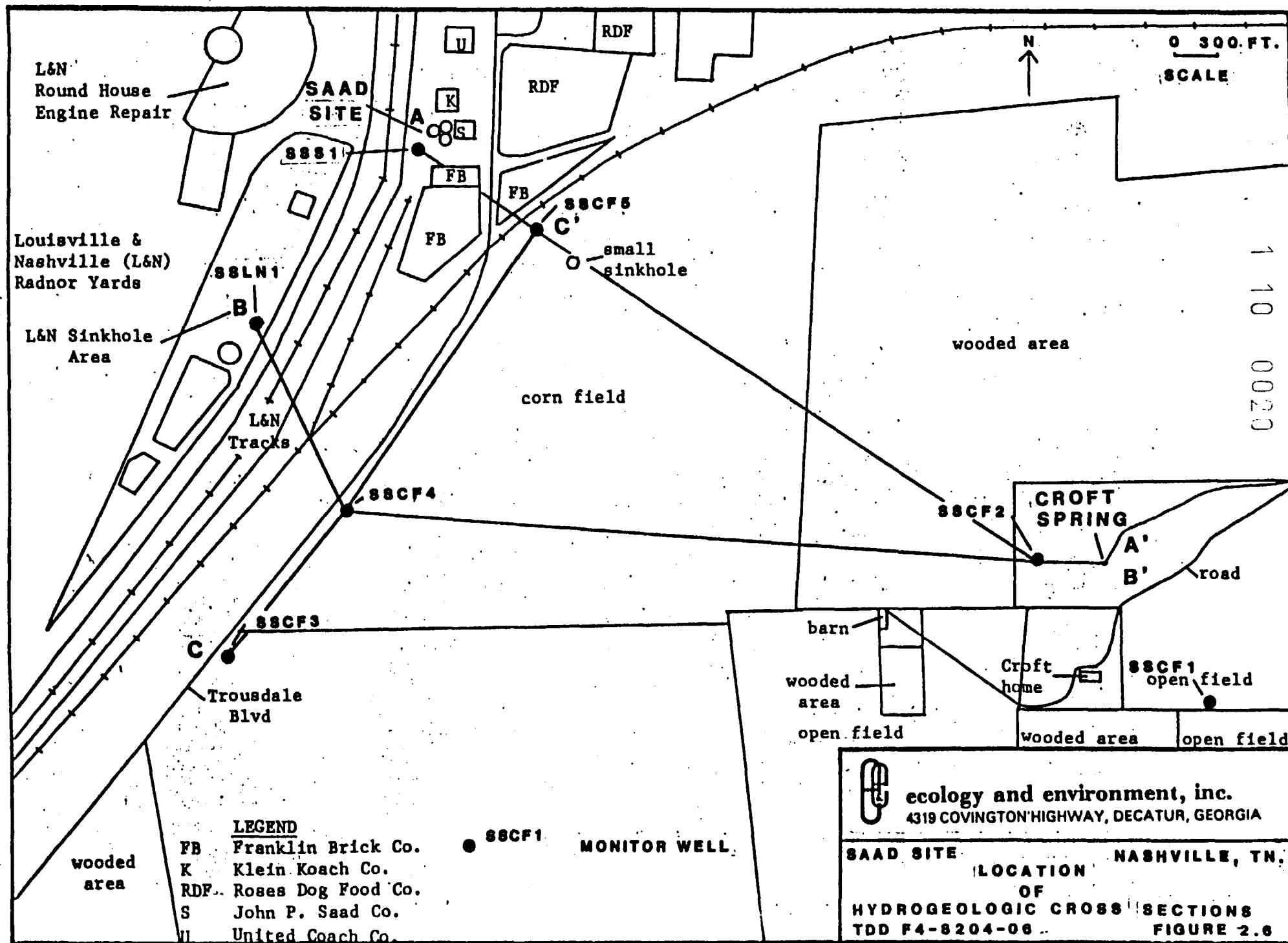


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SAAD SITE NASHVILLE, TN.
POTENTIOMETRIC SURFACE
OF
BIGBY-CANNON LIMESTONE AQUIFER
OCTOBER 19, 1982
TDD F4-8204-06 FIGURE 2.5

zones may exist west, south and north of the Saad Site. Further ground-water investigations are needed to identify these zones.

The geologic interpretations are based on the lithologic descriptions of the well cores and cuttings. Appendix B contains the descriptions made by a hand lens inspection of the cores and by a binocular microscope inspection of the cuttings. The Bigby-Cannon Limestone and the Hermitage Formation both showed lithologic similarities to the description of these units in publications on the geology of Middle Tennessee (Wilson and Fullerton, 1965) (Wilson and Miller, 1972). Figure 2.6 shows the locations of three hydrogeologic cross sections and Figures 2.7, 2.8 and 2.9 show the cross sections. The cross sections show the relationship between the geologic units, the locations of the water producing zones (WPZ), the apparent smells from wells and the potentiometric surface of the aquifer. The potentiometric surface rises above the top of the aquifer at Well SSCF4 and Well SSS1 indicating a local artesian condition. This artesian or confined condition at Well SSCF4 may be due in part to the thick overburden (soil and clay) in the area of the well. The artesian condition at Well SSS1 may be due in part to the thick overburden (soil, fill and waste material) in the sinkhole area and due in part to the reported concrete dumped into the sinkhole which may have decreased porosity and permeability in fractures and/or solution cavities around the perimeter of the sinkhole.



North
west

590

580

570

560

550

540

530

520

510

500

Elevation
Above Mean
Sea Level

A
Saad Site
SSS1

SSCF5

SSCF2

A'
Croft
Spring

South
east

590

580

570

560

550

540

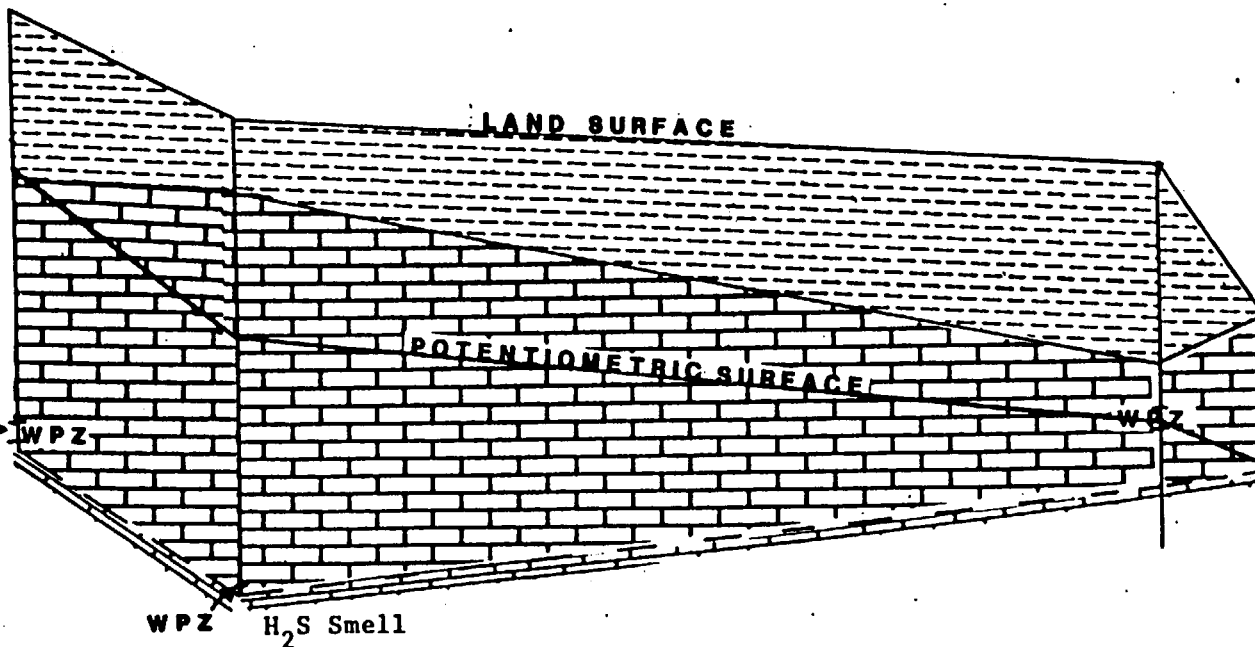
530

520

510

500

H₂S
Smell



WPZ

H₂S Smell

WPZ

0 300 Feet
Scale



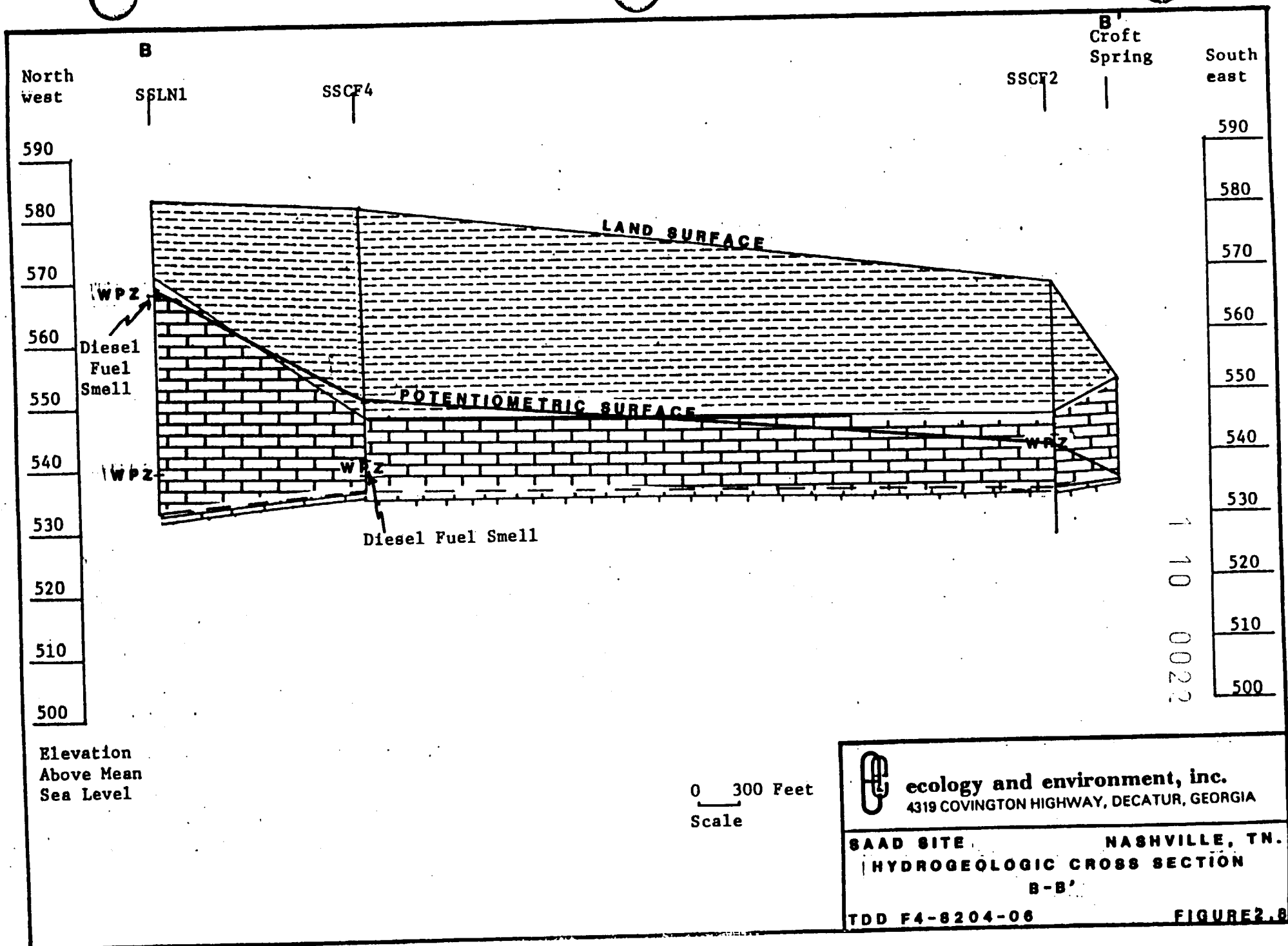
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SAAD SITE NASHVILLE, TN.
HYDROGEOLOGIC CROSS SECTION
A-A'

TDD F4-8204-06

FIGURE 2.7

110 0021



South

590

580

570

560

550

540

530

520

510

500

Elevation
Above Mean
Sea Level

C

SSCF3

SSCF4

C'

SSCF5

North

590

580

570

560

550

540

530

520

510

500

1100023

Diesel Fuel
Smell

WPZ

LAND SURFACE

GEOMETRIC

SURFACE

WPZ

Diesel Fuel
Smell

WPZ H₂S Smell

0 300 Feet
Scale



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SAAD SITE NASHVILLE, TN.
HYDROGEOLOGIC CROSS SECTION
C-C'

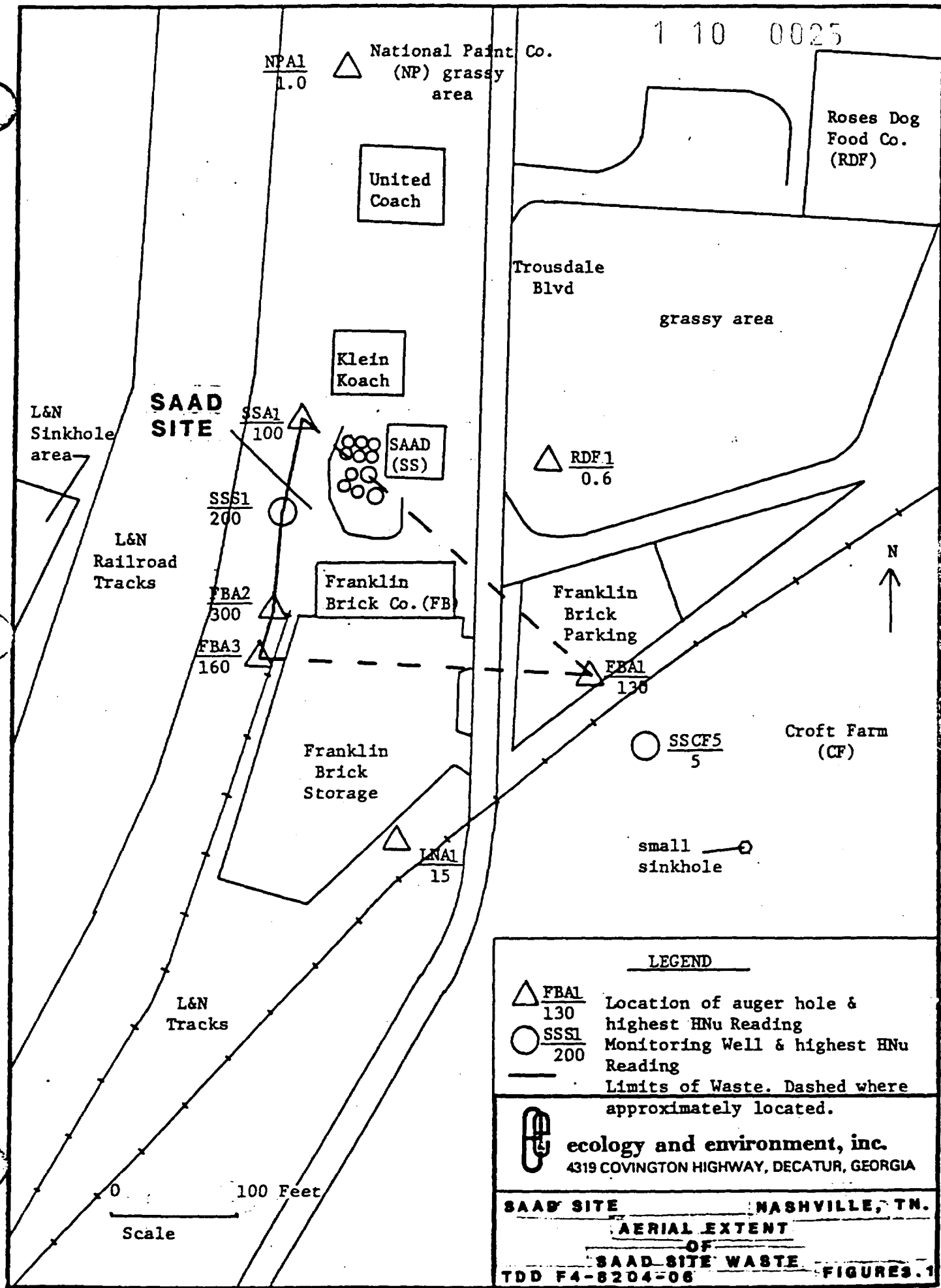
TDD F4-8204-06

FIGURE 2.9

3.1 LOCATION

The Saad Site waste is located generally in a triangle from the Saad property at the northwest corner, to the Franklin Brick Company railroad spur track at the southwest corner, to the Franklin Brick Company parking area at the east corner. Figure 3.1 shows the location of this triangle and the data point locations from which HNU readings were obtained. Seven auger holes were drilled at selected locations to identify the soil and apparent waste in the area. HNU readings in the auger holes varied from 0.6 ppm outside the waste triangle on Roses Dog Food Company property to 300 ppm inside the triangle behind the Franklin Brick Company warehouse. A description of the soil and apparent waste found in the auger holes is contained in Appendix B. Figure 3.2 shows a north-south cross section of the apparent waste behind the Saad and Franklin Brick buildings. A significant fact is that while apparent waste with high HNU readings were encountered above the Bigby-Cannon Limestone in Well SSS1, no apparent similar waste with corresponding high HNU readings were encountered in the fractures and/or solution cavities at the base of the Bigby-Cannon. Only a smell similar to hydrogen sulfide gas was evident in the SSS1 well development water. This gas may be related to the domestic landfill operations in the sinkhole prior to Saad's operations. In support of this assumption, Franklin Brick Company vents gas from beneath its foundation to the atmosphere. The gas has been reported to be methane and ethane which are gases associated with landfill operations (England, 1982). An HNU reading of the vented gas was 13 ppm; an HNU reading during the SSS1 well development was 18 ppm. Sampling of the gases from Wells SSS1 and SSCF5 as well as from the Franklin Brick vent pipe would serve to definitely identify the gases and to aid in determining the source of the gases. Based on these data there is apparently no major hydraulic connection at Well SSS1 between the apparent waste above the limestone and the water producing zone at the base of the limestone. Although Don Rima reported an oily substance on the water level measuring tape on October 19, 1982, the source of the oily substance is inconclusive at this time. Further sampling is necessary to identify this oily substance, and further

1 10 0025



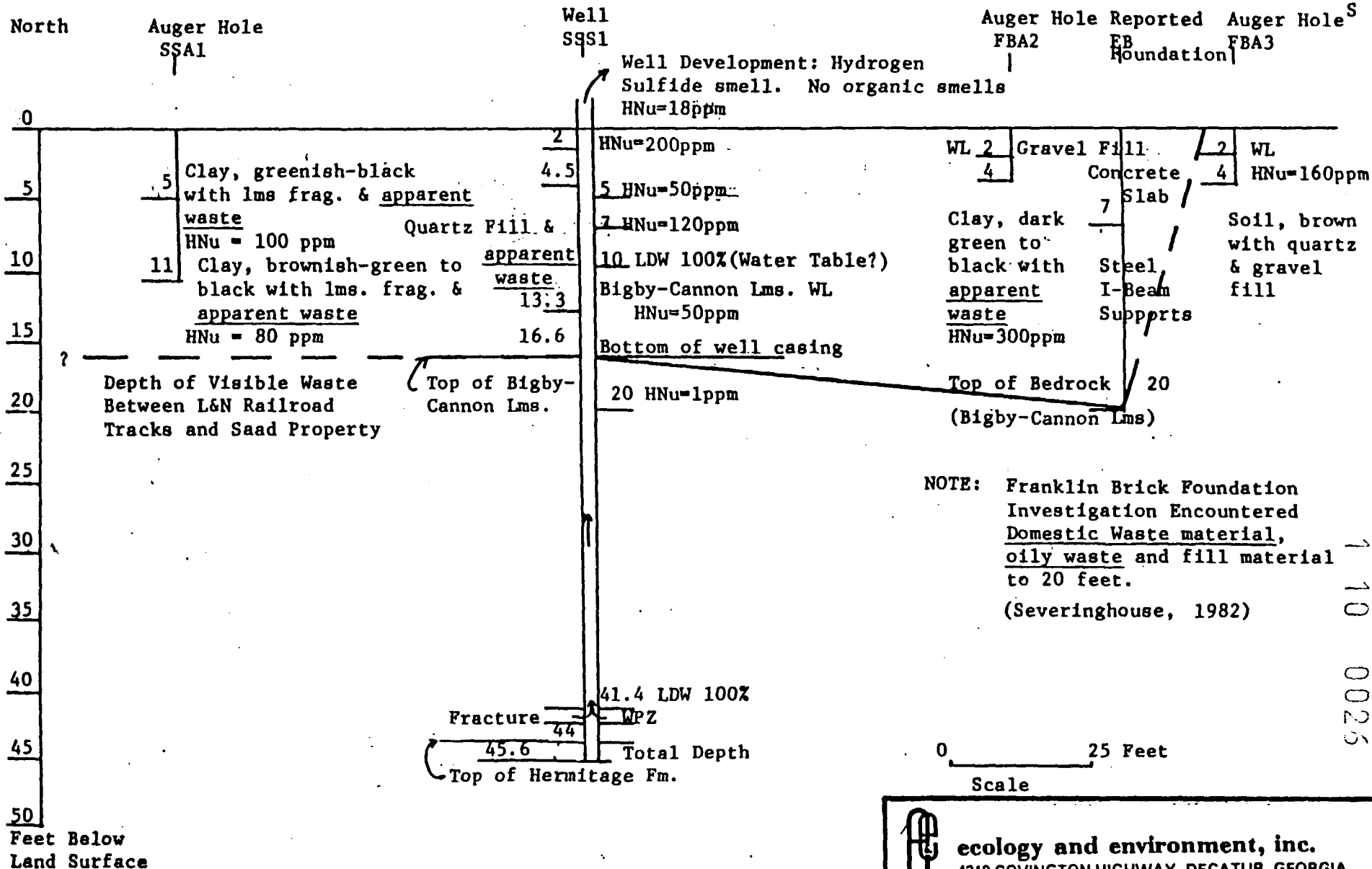
LEGEND

- \triangle FBA1
130 Location of auger hole & highest HNu Reading
- \bigcirc SSS1
200 Monitoring Well & highest HNu Reading
- Limits of Waste. Dashed where approximately located.



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SAAD SITE NASHVILLE, TN.
AERIAL EXTENT
OF
SAAD SITE WASTE **FIGURE 1**
TDD F4-8204-06



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SAAD SITE NASHVILLE, TN.
NORTH-SOUTH CROSS SECTION
OF
SAAD SITE WASTE
TDD F4-8204-06 FIGURE 3.2

hydrologic investigation is needed to determine the degree of hydraulic connection, if any, between the waste and the water producing zones.

3.2 VOLUME ESTIMATION

Based on existing data the Saad Site waste has impacted a surface area of approximately 0.6 acre. The depth of the waste is approximately 20 feet and it underlies structures on the Saad and Franklin Brick properties. The volume of waste and contaminated soil is approximately 18,650 cubic yards. The waste is concentrated behind the Saad and Franklin Brick properties between those buildings and the multiple L & N tracks. Due to the building foundations and the L & N railroad track foundation this area is not easily accessible to a great amount of excavation.

SECTION 4 - CONCLUSIONS

The installation of ground-water monitoring wells at the Saad Site, L & N property, and Croft Farm has resulted in a limited understanding of the local hydrogeology as well as waste characteristics. The hydrogeology between the Saad Site, L & N and the Croft Farm is comprised of the fractured and solution cavity prone Bigby-Cannon Limestone underlain by the confining Hermitage Formation. The major water producing zones of the limestone are present at the base of the limestone unit. The drilling and development of Wells SSCF3, SSCF4, and SSLN1 resulted in a smell similar to diesel fuel. Wells SSCF3 and SSCF4 on the Croft Farm are hydrologically down gradient of Well SSLN1 on the L & N property. The drilling and well development of Wells SSS1 and SSCF5 resulted in a smell similar to hydrogen sulfide gas. Well SSCF5 on the Croft Farm is hydrologically down gradient of Well SSS1 on the Saad Site. The Croft Spring is hydrologically down gradient of all wells except SSCF1. The placement of the wells confirmed the previously acquired geophysical data indicating that electrical resistivity is a very useful and efficient exploration tool to use in this type of hydrogeology.

The data derived from the auger holes and Well SSS1 indicate that the Saad Site waste is localized within an area near the site and is apparently contained above the Bigby-Cannon Limestone. Water quality data as yet incomplete, will serve to quantify the types of wastes and will aid in determining the source(s) of the wastes which have been reported in the Croft Spring.

SECTION 5 - RECOMMENDATIONS

Due to the as yet incomplete water quality analyses of ground-water and environmental soil samples, it is premature at this time to recommend further work at the Saad Site. Generally, a further understanding of the hydrogeologic conditions in the areas north, west, and south of the site is necessary to identify other possible ground-water flow paths away from the site and the L & N property. Once the analytical results are finalized specific recommendations can be made to further characterize the Saad Site.

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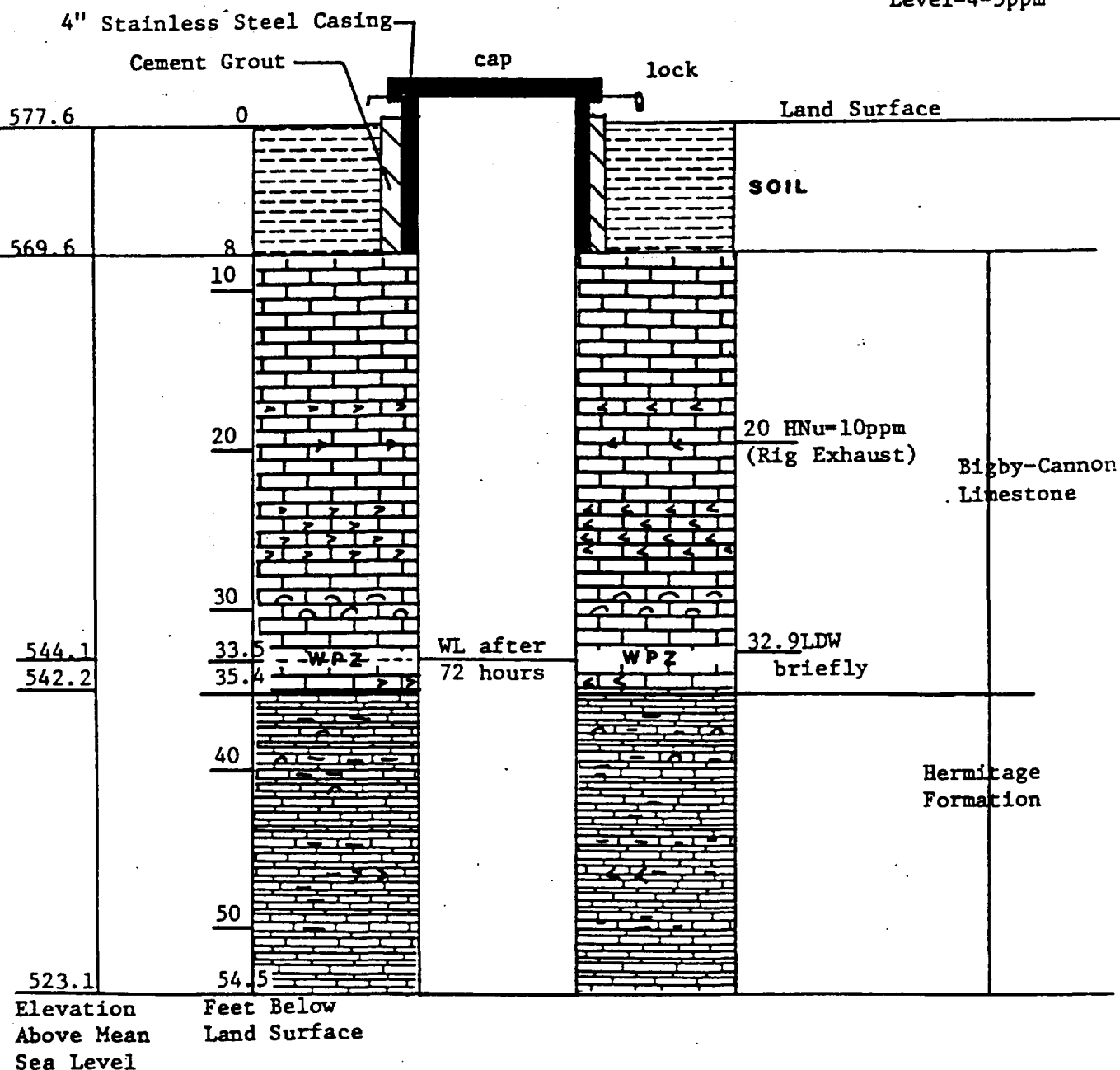
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1 10 0031

APPENDIX A
DRAWINGS
OF
MONITORING WELL CONSTRUCTION

HNu Background
Level=4-5ppm



Date Began: 8-19-82
Date Completed: 8-24-82

Vertical Scale: 1" = 10'
Horizontal Not To Scale
WIMP = TC
TC = 1.8FT > LS



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SAAD SITE

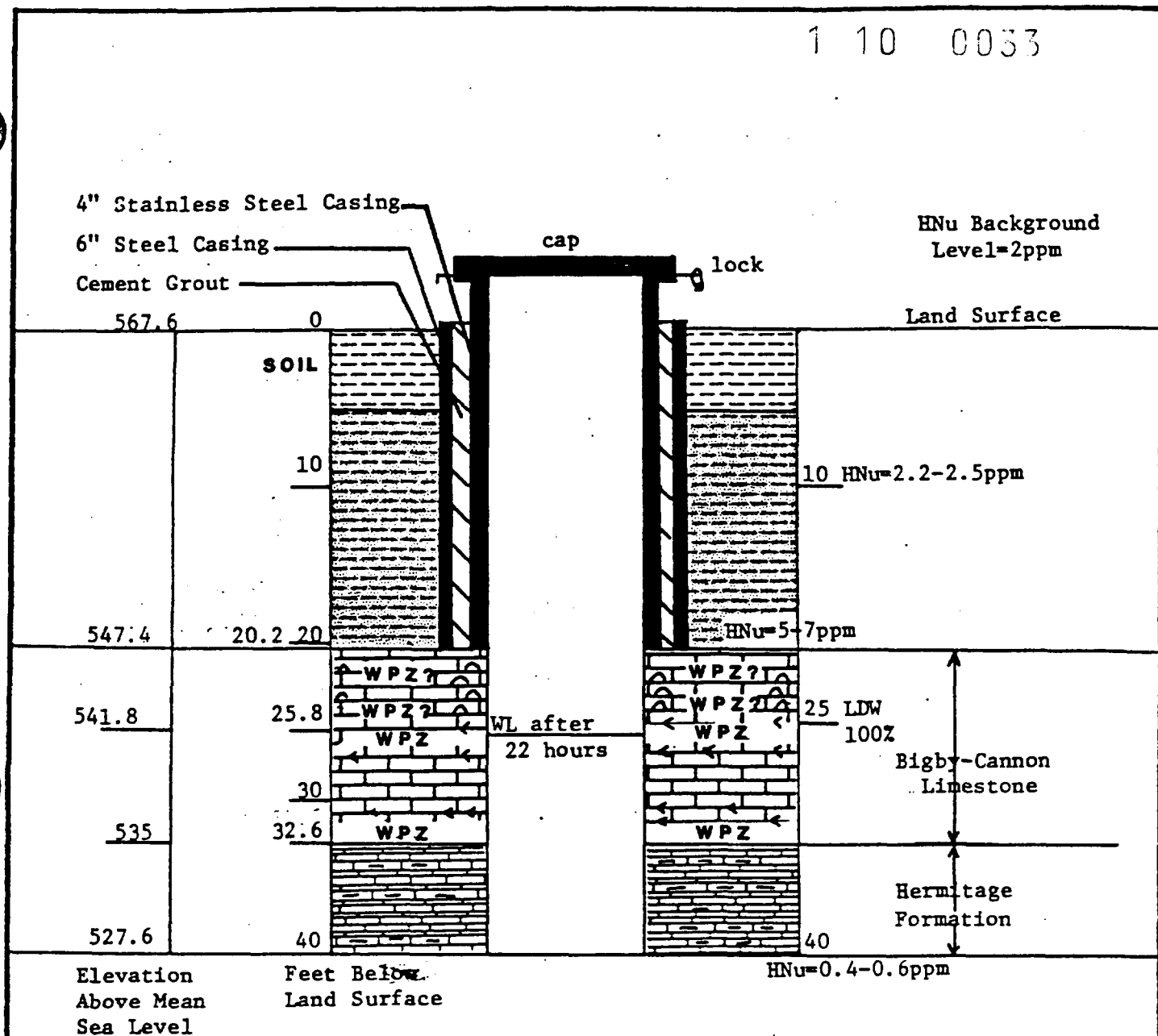
NASHVILLE, TN.

CONSTRUCTION OF WELL SSCF1

TDD F4-8204-06

FIGURE A.1

1 10 0033



Date Began: 8-25-82
Date Completed: 8-26-82

Vertical Scale: 1" = 10'
Horizontal Not To Scale
WLMP = TC
TC = 3.5FT > LS



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SAAD SITE

NASHVILLE, TN.

CONSTRUCTION OF WELL SSCF 2

TDD F4-8204-08

FIGURE A.2

4" Stainless Steel Casing

Cement Grout

cap

lock

HNu Background
Level=1.6-3ppm

Land Surface

595.7

SOIL

10

15

20

30

565

30.7

561.9

33.8

WL after
48 hoursBentonite Pellet Seal
Backfill of Ctgs. (10-33.8 Feet)

20 HNu=2ppm

24 Ctgs. Wet

Slight Diesel Fuel
SmellLDW Sheen on water
HNu=3ppm

briefly

37.5 Sheen
and Diesel
Fuel Smell
42.5Bigby-Cannon
Limestone

552.7

41.5

43.7

552
Elevation
Above Mean
Sea LevelFeet
Below
Land Surface

43' LDW50%

LDW100%

Hermitage
FoundationNOTE: Distinct diesel fuel smell
while developing with air.
HNu=10ppm

Date Began: 8-26-82

Date Completed: 8-30-82

Vertical Scale: 1" = 10'
Horizontal Not To Scale
WLMP = TC
TC = 2.2FT > LSecology and environment, inc.
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SAAD SITE

NASHVILLE, TN.

CONSTRUCTION OF WELL SSCF 3

TDD F4-8204-06

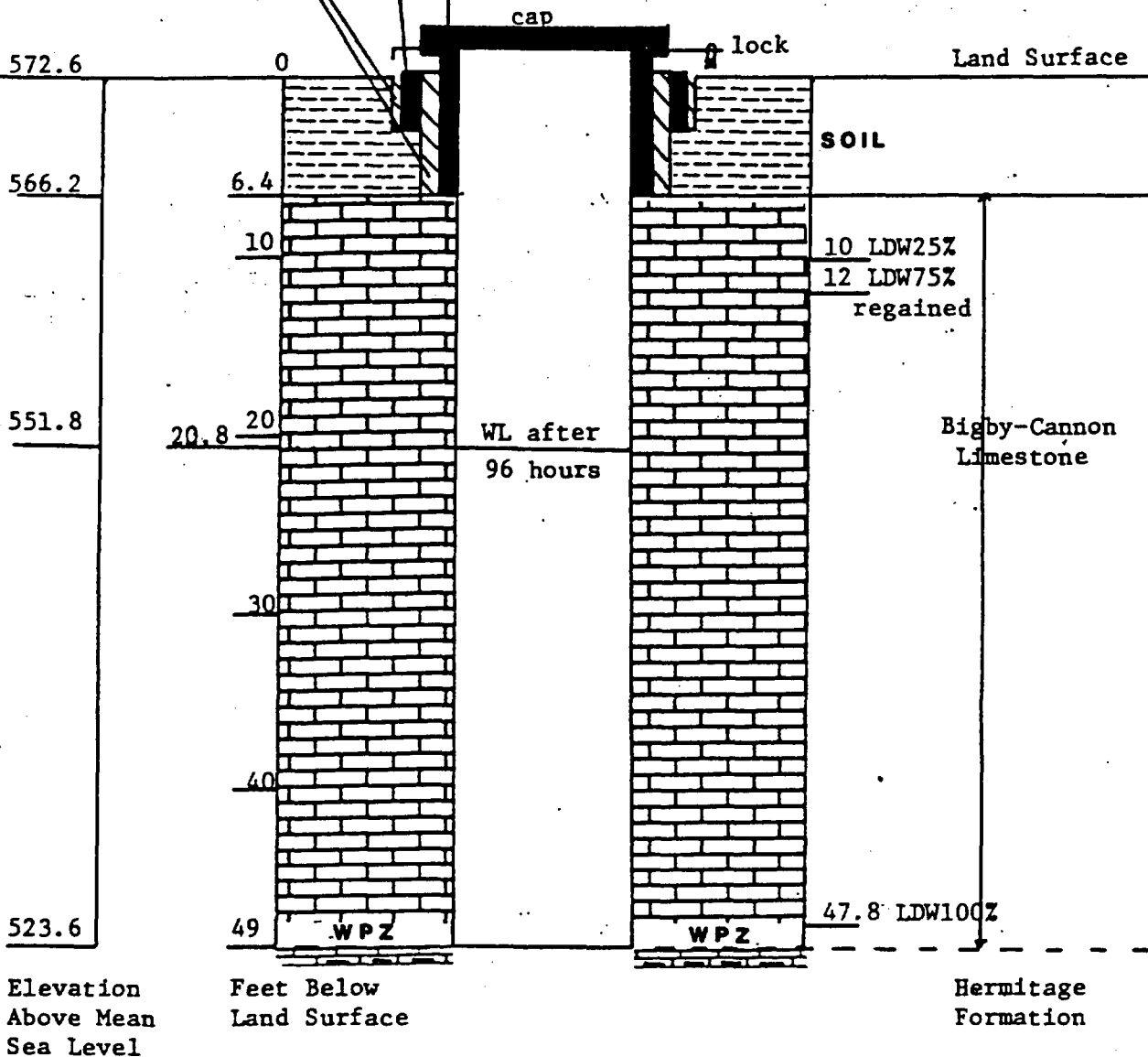
FIGURE A.3

FIGURE 5A.4

1 10 0036

4" Stainless Steel Casing
8" PVC Casing
Cement Grout

HNu Background
Level=1-3ppm



Elevation
Above Mean
Sea Level

Feet Below
Land Surface

Hermitage
Formation

NOTE: Hydrogen Sulfide Smell
while developing with air.
HNu=5ppm

Date Began: 9-7-82

Date Completed: 9-9-82

Vertical Scale: 1" = 10'

Horizontal Not To Scale

WLMP = TC

TC = 1.7FT > LS



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SAAD SITE

NASHVILLE, TN.

CONSTRUCTION OF WELL SSCF 5

TDD F4-8204-06

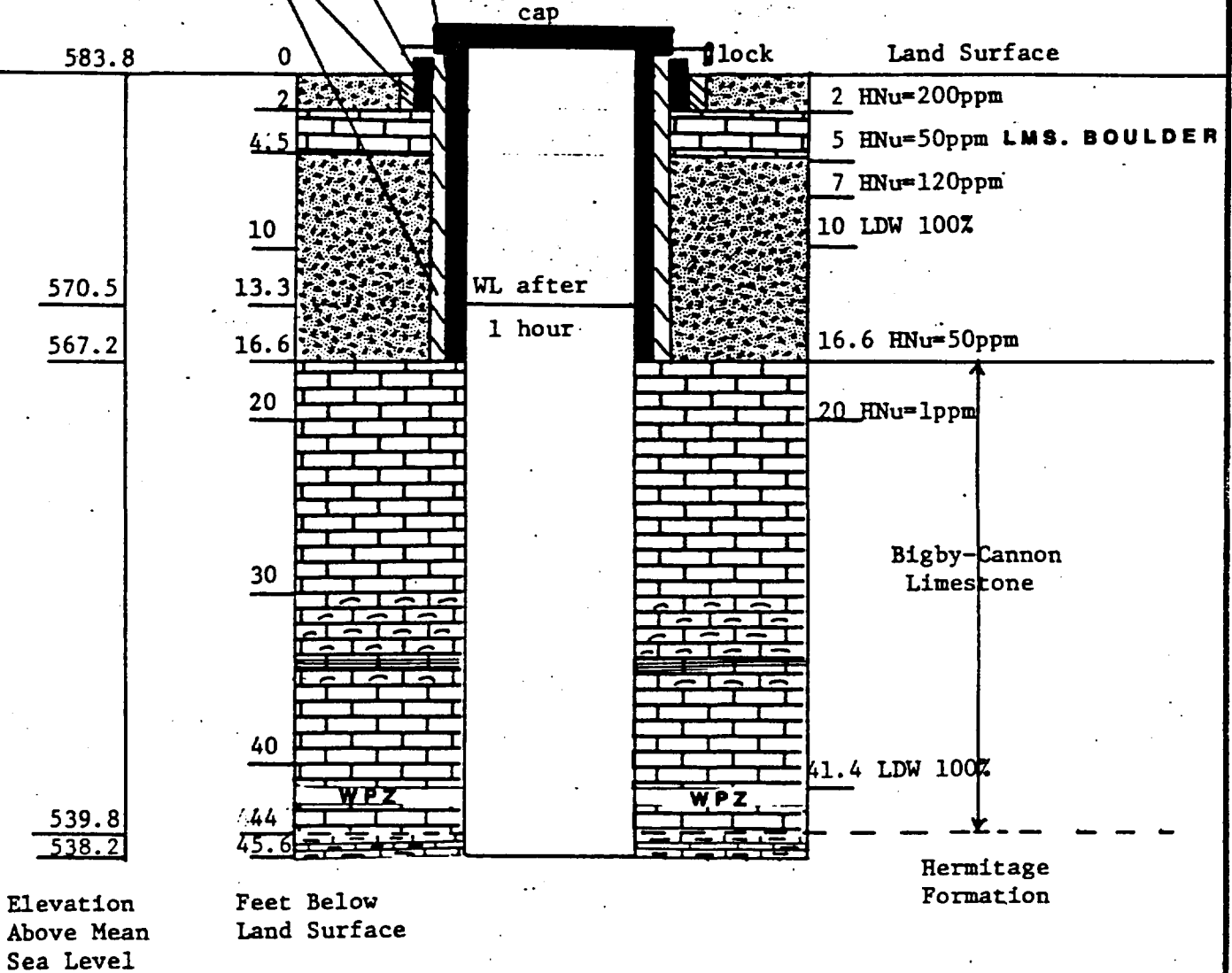
FIGURE A.5

FIGURE A.6

1 10 0038

4" Stainless Steel Casing
8" PVC Casing
Cement Grout

HNu Background
Level: 1.2-2ppm



NOTE: Hydrogen Sulfide Smell
During Development with air.
Brown to Black water; foamy.
HNu=18ppm
Date Began: 9-14-82
Date Completed: 9-17-82

Vertical Scale: 1" = 10'
Horizontal Not To Scale
WLMP = TC
TC = 2.2FT > LS



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SAAD SITE

NASHVILLE, TN.

CONSTRUCTION OF WELL S881

TDD F4-8204-06

FIGURE A.7

APPENDIX B
LITHOLOGIC DESCRIPTIONS
OF
MONITORING WELLS
AND
AUGER HOLES

LITHOLOGIC DESCRIPTIONS
OF WELL # SSCF 1
SAAD SITE, NASHVILLE, TENNESSEE

DEPTH IN FEET BELOW LAND SURFACE	LITHOLOGIC DESCRIPTION
0 - 5 Cuttings (Ctgs.)	Soil, brown to brownish-black with minor amounts of weathered limestone fragments.
5 - 8 Ctgs.	Same as above.
8 - 11.1 Core	Calcarenite, medium gray to gray, medium-to very coarse-grained with common shell fragments, thin-bedded with common shale laminations. Bigby-Cannon Limestone.
11.1 - 12 Core	Calcarenite, light grayish-brown to brown, medium-to very coarse-grained with abundant shell fragments at 12 feet, thin-bedded with minor shale laminations, vuggy with abundant brown phosphate pellets, calcite recrystallization in vugs. Bigby-Cannon Limestone.
12 - 18 Core	Calcarenite, light grayish-brown to gray, medium-to very coarse-grained, thin-bedded, cross-bedded with abundant shale laminations, minor fossils; broken brown limestone fragments at 12.8 feet; vuggy between 17 and 17.5 feet. Bigby-Cannon Limestone.
18 - 24 Core	Calcarenite, light grayish-brown to light gray, medium-grained, thin-bedded, cross-bedded with shale laminations; vug one inch in diameter at 19.5 feet. Bigby-Cannon Limestone.
24 - 27.5 Core	Calcarenite, light gray, medium-grained, thin-bedded, cross-bedded with minor shale laminations; vugs common but not interconnected. Bigby-Cannon Limestone.
27.5 - 30.9 Core	Calcarenite, gray to dark gray, medium grained, thin-bedded, cross-bedded with abundant shale laminations; minor shell fragments between 30 and 30.9 feet. Bigby-Cannon Limestone.
30.9 - 33.5 Core	Bioclastic Limestone, light to medium gray, medium-to coarse-grained, thin-bedded, cross-bedded with minor shale laminations; abundant fossils, brachiopods? Bigby-Cannon Limestone.

WELL # SSCF 1 (page 2)

DEPTH IN FEET
BELOW LAND SURFACELITHOLOGIC
DESCRIPTION

33.5 - 35.4 Core

Calcarenite, gray to grayish-brown, medium-to coarse-grained with common phosphate pellets, thin-bedded, cross-bedded with laminated to thin-bedded shale, common fossil fragments; recrystallized calcite inside three inch diameter vug at 35.2 feet. Bigby-Cannon Limestone.

35.4 - 44 Core

Argillaceous Limestone, gray to grayish-black, fine-grained, thin-bedded with shale laminations, common fossils, brachiopods? Hermitage Limestone.

44 - 50.2 Core

Argillaceous Limestone, gray to grayish-black, fine-to medium-grained, thin-bedded, cross-bedded with common thin-bedded shale and three major coquina facies zones at 44.6 - 45.2, 47.6 - 48.2 and 49.8 - 50.2 feet, abundant shell fragments, brachiopods? vugs scarce, one vertical fracture at 46.6 feet. Hermitage Limestone.

50.2 - 54.2 Core

Argillaceous Limestone, gray to grayish-black, fine-to medium-grained, very thin to thin-bedded, cross-bedded with shale laminations. Hermitage Formation.

LITHOLOGIC DESCRIPTIONS
OF WELL # SSCF 2
SAAD SITE, NASHVILLE, TENNESSEE

DEPTH IN FEET BELOW LAND SURFACE	LITHOLOGIC DESCRIPTION
0 - 5 Ctgs.	Soil, brown to brownish-red, clayey, slightly moist.
5 - 15 Ctgs.	Clay, brown to brownish-red with fine-grained quartz and minor weathered limestone fragments, slightly moist.
15 - 20 Ctgs.	Clay, brown to brownish-red with minor fine-grained quartz and phosphate pellets, moist.
20 - 20.2 Core	Same as above.
20.2 - 23.5 Core	Calcarenite, light to dark gray, medium-to coarse-grained, thin-bedded, cross-bedded with shale laminations, fossils common, brachiopods? phosphate pellets common, weathers to brown to black (phosphatic?) limestone, fractures at 21 and 23.5 feet. Bigby-Cannon Limestone.
23.5 - 26 Core	Same as above; vuggy.
26 - 27.3	(No core return, fractures)
27.3 - 32.6 Core	Same as 20.2 - 23.5 feet core; abundant shell fragments and vuggy from 31 to 32 feet, vertical fractures common at 32.3 feet.
32.6 - 35.7 Core	Argillaceous Limestone, light to medium gray, fine-grained, thin-bedded, cross-bedded with shale laminations, vugs scarce, Hermitage Formation.

LITHOLOGIC DESCRIPTIONS
OF WELL # SSCF 3
SAAD SITE, NASHVILLE, TENNESSEE

DEPTH IN FEET BELOW LAND SURFACE	LITHOLOGIC DESCRIPTION
0 - 5 Ctgs.	Soil, brown to reddish-brown, clayey.
5 - 10 Ctgs.	Same as above with limestone fragments and phosphate pellets.
10 - 15 Ctgs.	Same as above; slightly moist.
15 - 20 Ctgs.	Clay, brown to black with limestone fragments and phosphate pellets, moist.
20 - 25 Ctgs.	Clay, brown to reddish-brown with fine-grained quartz, limestone fragments and phosphate pellets.
25 - 30	(No return on auger blades.)
30 - 33.8 Ctgs.	Clay, brown to grayish-brown with fine-grained quartz and phosphate pellets, wet.
33.8 - 37	(No return.)
37 - 39 Ctgs.	Calcarenite, light-gray, medium-grained with minor shale. Bigby-Cannon Limestone.
39 - 42.5	(No return.)
42.5 - 43 Ctgs.	Same as 37 - 39 feet.
43 - 43.7	(No return.)

LITHOLOGIC DESCRIPTIONS
OF WELL # SSCF 4
SAAD SITE, NASHVILLE, TENNESSEE

DEPTH IN FEET BELOW LAND SURFACE	LITHOLOGIC DESCRIPTION
0 - 5 Ctgs.	Soil, brown, clayey.
5 - 8.7 Ctgs.	Same as above.
8.7 - 10 Ctgs.	Clay, brown with white limestone fragments and black phosphate pellets.
10 - 25 Ctgs.	Same as above.
25 - 34	(No return.)
34 - 38 Ctgs.	Calcarenite, light gray, medium-grained with minor shale. Bigby-Cannon Limestone.
38 - 41.7 Ctgs.	Calcarenite, gray to dark gray, medium-grained with common shale and minor phosphate pellets. Bigby-Cannon Limestone.
41.7 - 43	(No return.)
43 - 43.5 Ctgs.	Calcarenite, gray to dark gray, medium-grained with common shale and brown limestone; minor phosphate pellets. Bigby-Cannon Limestone.
43.5 - 45.6	(No return.)
Discharge during well development - Ctgs.	Limestone fragments, white, brown and rose colored; black phosphate pellets; fine-to coarse-grained quartz, clear to brown, angular to well rounded. Bigby-Cannon Limestone?

LITHOLOGIC DESCRIPTIONS
OF WELL # SSCF 5
SAAD SITE, NASHVILLE, TENNESSEE

DEPTH IN FEET BELOW LAND SURFACE	LITHOLOGIC DESCRIPTION
0 - 5 Ctgs.	Soil, brown, clayey and silty.
5 - 6.4 Ctgs.	Same as above.
6.4 - 10 Ctgs.	Calcarenite, light gray to brownish-white, medium-grained with common phosphate pellets. Bigby-Cannon Limestone.
10 - 15 Ctgs.	Calcarenite, gray to dark gray, medium-grained with common phosphate pellets and shale. Bigby-Cannon Limestone.
15 - 20 Ctgs.	Calcarenite, gray to brownish-gray, medium- grained with common phosphate pellets and shale. Bigby-Cannon Limestone.
20 - 30 Ctgs.	Same as above.
30 - 45 Ctgs.	Calcarenite, gray to dark gray, medium-grained with common shale. Bigby-Cannon Limestone.
45 - 47.5 Ctgs.	Calcarenite, gray to brownish-gray, medium- grained with common brown limestone fragments, phosphate pellets and shale. Bigby-Cannon Limestone.
47.5 - 48 Ctgs.	Calcarenite, gray to dark gray, fine-to medium- grained with common brown to white limestone fragments and phosphate pellets. Bigby-Cannon Limestone.
48 - 49	(No return.)

LITHOLOGIC DESCRIPTIONS
OF WELL # SSLN 1
SAAD SITE, NASHVILLE, TENNESSEE

DEPTH IN FEET BELOW LAND SURFACE	LITHOLOGIC DESCRIPTION
0 - 5 Ctgs.	Quartz, clear, white to brown and red, fine- to medium-grained, subangular to well-rounded with clay and silt common. Fill Material.
5 - 10 Ctgs.	Quartz, brown to white, medium- to coarse-grained, subangular to angular with common clay and phosphate pellets. Partial Fill Material.
10 - 11.5 Ctgs.	Same as above with limestone fragments.
11.5 - 15 Ctgs.	Calcarenite, light gray to brown-stained, medium- to coarse-grained with common shale and phosphate pellets. Bigby-Cannon Limestone.
15 - 35 Ctgs.	Calcarenite, light gray to gray, medium-grained with minor shale and phosphate pellets. Bigby-Cannon Limestone.
35 - 45 Ctgs.	Calcarenite, gray to dark gray, medium-grained with common shale and minor phosphate pellets; brown weathered limestone fragments at 44.2 - 44.4 feet. Bigby-Cannon Limestone.
45 - 50 Ctgs.	Calcarenite, gray to dark gray and brown, medium-grained with abundant shale and common phosphate pellets. Bigby-Cannon Limestone.
50 Ctgs.	Argillaceous Limestone, dark gray, fine-grained with common phosphate pellets. Hermitage Formation.

LITHOLOGIC DESCRIPTIONS
OF WELL # SSS 1
SAAD SITE, NASHVILLE, TENNESSEE

DEPTH IN FEET BELOW LAND SURFACE	LITHOLOGIC DESCRIPTION
0 - 2 Ctgs.	Quartz, brown, fine-to medium-grained, subangular to angular with limestone fragments and clay; Hazardous Material Mixture.
2 - 4.5 Core	Calcarenite, light gray to brownish-gray, fine- to medium-grained, thin-bedded, cross-bedded with shale laminations; Boulder Fill.
4.5 - 16.6 Ctgs.	Same as 0 -2 feet; composite of mud pit residue; Hazardous Material Mixture.
16.6 - 18.3 Core	Calcarenite, light gray to gray, medium-to coarse-grained, thin-bedded, cross-bedded with shale laminations. Bigby-Cannon Limestone.
16.6 - 30 Ctgs.	Calcarenite, gray to dark gray, fine-to medium-grained with common shale. Bigby-Cannon Limestone.
30 - 35 Ctgs.	Same as above with shell fragments and phosphate pellets; abundant black shale at 34 feet. Bigby-Cannon Limestone.
35 - 40 Ctgs.	Calcarenite, gray to brownish-gray, medium-grained with common black shale. Bigby-Cannon Limestone.
40 - 41.4 Ctgs.	Calcarenite, gray to brownish-gray, medium-grained. Bigby-Cannon Limestone.
41.4 - 45.6	(No return.)
Well Development Discharge	Calcarenite, gray to white, medium-grained; quartz, clear to brown, subangular to well rounded; abundant fossil fragments; common phosphate pellets. Bigby-Cannon Limestone.

LITHOLOGIC DESCRIPTIONS
OF AUGER HOLES
SAAD SITE, NASHVILLE, TENNESSEE

AUGER HOLE NUMBER	DEPTH IN FEET BELOW LAND SURFACE	LITHOLOGIC DESCRIPTION
FBA 1	0 - 2 Ctgs.	Gravel Fill.
	2 - 5 Ctgs.	Soil, black to brownish-black, clayey with apparent waste material.
	5 - 8 Ctgs.	Clay, black to grayish-black with apparent waste material, moist.
FBA 2	0 - 4 Ctgs.	Clay, dark green to black, silty with gravel fill and apparent waste material.
FBA 3	0 - 4 Ctgs.	Clay, brown, silty with coarse-grained quartz and gravel fill.
LNA 1	0 - 10 Ctgs.	Soil, brown, clayey with limestone rock fragments.
RDFA 1	0 - 5 Ctgs.	Same as above.
NPA 1	0 - 6 Ctgs.	Soil, brown to black, clayey.
SSA 1	0 - 5 Ctgs.	Clay, greenish-black with limestone fragments and apparent waste material.
	5 - 11 Ctgs.	Clay, brownish-green to black with limestone fragments and apparent waste material.